# A SYNOPSIS OF THE FLEAS FOUND ON *MUS NORWEGICUS DECUMANUS*, *MUS RATTUS ALEXANDRINUS* AND *MUS MUSCULUS*.

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The three species of the genus *Mus* mentioned above follow in the wake of civilised man and may be looked upon as more or less domestic animals. Moreover, when they appear in any new locality, they seem to possess the power of eliminating the previously established native species of rats and mice, and they thus obtain for themselves a wider field and the opportunity for a rapid permanent increase in number of individuals. Of the three, *Mus rattus* alone habitually infests ships, but by accidental transference in vessels from port to port all three have become distributed throughout the world. Australia is especially rich in peculiar local species of rats, abundantly distinct from, but to some extent resembling, *Mus rattus*. This circumstance renders it not improbable that on occasion animals from Australia may have been incorrectly identified with that cosmopolitan species.

In connection with the spread of plague the three species under consideration are of prime importance, and not less important are the fleas which are parasitic on them. The object of the present paper is to assist students and others towards the rapid identification of the fleas usually found on the common rats and mice.

Family I. Chigoes (Sarcopsyllidæ).—The rostrum (= labium + labial palpi) consists of three, or fewer, very feebly chitinized segments. The genal edge of the head is in all cases produced downwards into a triangular lobe situated behind the mouth-parts (fig. 1). There are no combs. The three segments of the thorax are always shorter than the first abdominal tergite.

The Sarcopsyllidæ are not in any way confined to one host and therefore many of the species may occur on rats. They usually attack the head and ears, and more rarely the feet.

*Key to the Genera.*

*a*. Hind coxa without a patch of spines on the inside.
  *a*¹. Hind femur simple ..... 1. *Dermatophilus*.
  *b*¹. Hind femur with a large tooth-like projection near the base .. 2. *Hectopsylla*.
*b*. Hind coxa with a patch of short spines on the *inside* (fig. 2) ..... 3. *Echidnophaga*.

### 1. Genus Dermatophilus, Guér.

Two species are known. Pregnant ♀ is much swollen and round, like a small pea.

1. **D. penetrans**, L. Eye distinct. Head and thorax of pregnant ♀ outside the swollen abdomen.—This is the common Chigoe or Jigger, which is a native of South America, but has been introduced into Africa.

2. **D. cæcata**, Enderl. Eye vestigial. Head and thorax of pregnant ♀ completely covered by the abdomen and lying in a cavity formed by the latter (fig. 3). Male unknown.—The species has been taken in Brazil on and behind the ears of *Mus rattus*.

### 2. Genus Hectopsylla, Frauenf.

This genus has not been found on rats or mice. It was originally confined to America, but one species has been introduced into aviaries in Europe.

### 3. Genus Echidnophaga, Olliff.

The genus belongs to warm countries in the eastern hemisphere. Numerous species are known, four of which have been found on rats.

*Key to the Species.*

*a*. Fifth tarsal segment with three heavy bristles, one small one and a thin long subapical hair on each side (fig. 4).

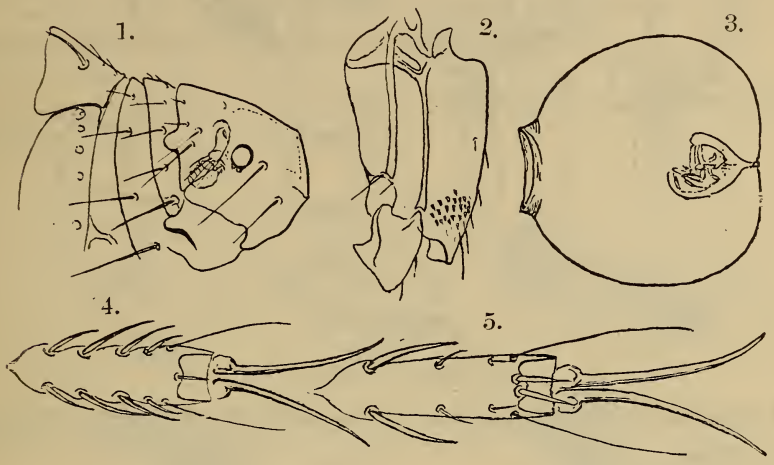
1. **E. gallinaceus**, Westw. Fifth tarsal segment with two ventral apical bristles (as in fig. 5); hind edge of head with a lateral lobe (fig. 1).—A common species, particularly on the heads of fowls, in tropical Asia and Africa; introduced into the United States. Also found on rats in Africa.

2. **E. myrmecobii**, Rothsch. Fifth tarsal segment with one ventral apical bristle (as in fig. 4); hind edge of head with a lateral lobe.—Belongs to Australia, where it has been taken on several indigenous animals and also on rats.

3. **E. murina**, Tirab. Fifth tarsal segment with one ventral apical bristle (fig. 4); hind edge of head without distinct lateral lobe.—A native of southern and south-eastern Europe, where it occurs on the heads of rats; it is apparently rare.

*b*. Fifth tarsal segment on each side with one heavy sub-basal bristle, a thinner median one and a small postmedian hair (fig. 5).

4. **E. liopus**, Rothsch. Found on rats in India; originally described from Western Australia, where it is plentiful on *Echidna*.

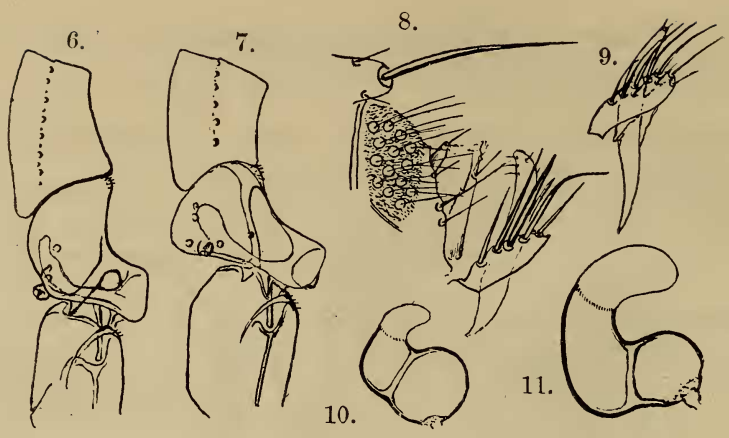



Family II. True Fleas (PULICIDÆ).—The rostrum (=labium+labial palpi) consists of four or more segments in the species found on rats and mice. Many species have combs of heavily chitinized spines. The majority of the known fleas belong here. For practical purposes they may be divided into two sections :—

Section 1.—Club of antenna distinctly segmented only on the hind side ("hind" side when lying in the groove).—(Section 2, p. 94.)

*Key to the Genera.*

*a*. No comb on head and thorax.
  *a*¹. The internal incrassation, which extends from the insertion of the mid coxa into the thorax, joins the anterior edge of the mesosternite (fig. 6) ..... 4. *Pulex*.
  *b*¹. This incrassation joins the upper edge of the mesosternite (fig. 7) ..... 5. *Xenopsylla*.
*b*. With a comb on the pronotum only ..... 6. *Hoplopsyllus*.
*c*. With a comb on the pronotum and at the lower edge of the head (figs. 12 & 13) ..... 7. *Ctenocephalus*.




4. Genus Pulex, L.

1. **P. irritans**, L. The human flea. Occasionally found on rats. Practically cosmopolitan.

5. Genus Xenopsylla, Glink.

The name *Loemopsylla*, Jord. and Rothsch., was published a little later than *Xenopsylla*, and must therefore give way to the latter. The genus includes numerous species from Africa: one of them (*cheopis*, Rothsch.) is now practically cosmopolitan, and another (*brasiliensis*, Baker) has been introduced into South America.

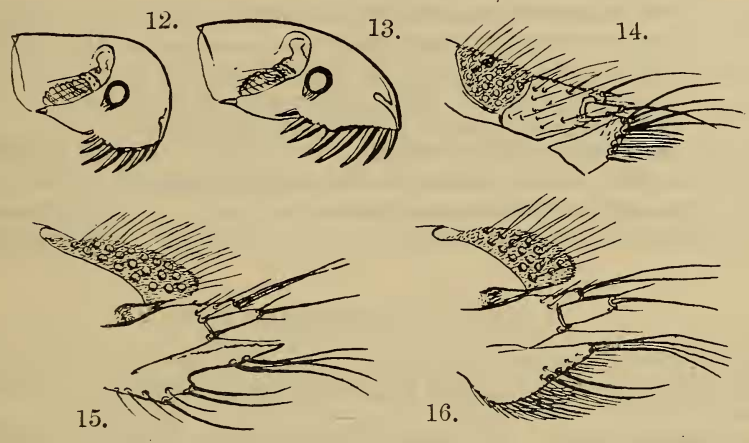
1. **X. cheopis**, Rothsch. In the ♂ the bristles of the flap-like process of the clasper all slender (fig. 9). In the ♀ the narrow portion of the receptaculum seminis long (fig. 11).—Originally discovered in Egypt. This is the common flea of rats in the tropics. Although practically cosmopolitan, it cannot apparently flourish in temperate and cold climates.

2. **X. brasiliensis**, Baker (=*vigetus*, Rothsch.). The bristles of the flap-like process of the clasper of the ♂ nearly all very stout, one of them elbowed (fig. 8); antepygidial bristle of male on a conical projection (fig. 8). The narrow part of the receptaculum seminis of the ♀ much shorter than in *X. cheopis*, and the rounded portion larger (fig. 10).—Occurs on rats in West Africa and has been introduced into Brazil. All the species of this genus are closely allied, and great care must be taken in their identification. The organs here figured are practically constant in each species.

### 6. Genus Hoplopsyllus, Baker.

Nearly related to *Pulex*. At once recognised by the prothorax bearing a comb, as in *Ceratophyllus*. The club of the antenna is segmented only on the hind side, as in *Pulex* and *Xenopsylla*, the first midtarsal segment is much shorter than the second, and the fifth tarsal segment in *all* the tarsi has four bristles on each side, besides a thin and long subapical hair. North American fleas; one species found on rats, but only once.

1. **H. anomalus**, Baker. The comb of the prothorax consists of about 8 to 10 spines.—Colorado and California.




### 7. Genus Ctenocephalus, Kolen.

Two species, which, although confounded by many authors, are easily distinguished by the shape of the head.

1. **Ct. canis**, Dugès. Frons of the head strongly rounded (fig. 12, ♂). Manubrium of clasper of ♂ widened at the end.—The flea commonly found on the dog, but also occurring on rats. Practically cosmopolitan, but more abundant in temperate countries than in the tropics.

2. **Ct. felis**, Bouché. Frons of the head much less rounded than in *canis*, the head therefore longer (fig. 13, ♂). Manubrium of the clasper (♂) only a little widened at the apex.—A widely distributed and very common flea all over the world on rats as well as many other animals.

Section 2.—Club of antenna distinctly segmented all round.

*Key to the Genera.*

*a*. Eye developed (*cf.* figs. 12, 13, & 26).
  $a^1$. No comb on head.
    $a^2$. Pygidium not projecting backwards (fig. 14); frons with tubercle ..... 8. *Ceratophyllus*.
    $b^2$. Pygidium strongly convex, projecting backwards (figs. 15 & 16); frons without tubercle ..... 9. *Pygiopsylla*.
  $b^1$. Two spines at angle of gena (fig. 26) ..... 10. *Chiastopsylla*.
*b*. Eye vestigial or absent (figs. 27 & 28).
  $a^1$. Abdomen without comb.
    $a^2$. Hind edge of tibiæ with about 8 short and several long bristles, which do not form a comb.
      $a^3$. Fifth segment in fore and mid tarsi with five, and in hind tarsus with four lateral bristles ..... 11. *Neopsylla*.
      $b^3$. Fifth segment in fore and mid tarsi with four and in hind tarsus with three lateral bristles, there being an additional pair of bristles in all the tarsi on the ventral surface in between the first pair ..... 12. *Ctenophthalmus*.
    $b^2$. Hind edge of tibiæ with about 12 short and 3 long bristles, the short ones forming a kind of comb ..... 13. *Ctenopsylla*.
  $b^1$. Abdomen with at least one comb ..... 14. *Hystrichopsylla*.

## 8. Genus Ceratophyllus, Curtis.

The number of species is very large; many of them are found on birds, but five only have been recorded from rats or house-mice.

1. **C. fasciatus**, Bosc. The comb of the prothorax consists of 18–20 spines. The movable process of the clasper of the ♂ (fig. 18) has the proximal edge angulate. The sternite of the seventh abdominal segment is slightly sinuous, without distinctly projecting lobe (fig. 20).—This species is common on *Mus norwegicus* in Europe, and occurs elsewhere as well.

2. **C. londiniensis**, Rothsch. The comb of the prothorax consists of 17–19 teeth. The movable process of the clasper of the ♂ is longer than in *fasciatus*, pointed and widest near the centre; its proximal margin is non-angulate (fig. 17). The sternite of the seventh abdominal segment of the female has a broad truncate lobe (fig. 19).—The species is widely distributed on rats and mice. It is apparently rare, but a large number of specimens were once taken in London (South Kensington).

3. **C. anisus**, Rothsch. The comb of the pronotum consists of 18 spines. The eighth abdominal sternite of the ♂ similar to that of *C. niger* (*cf.* fig. 23), but slenderer. The ♀ not known.—Originally described from Japan, where a ♂ was obtained off *Felis* sp. Another specimen was found at San Francisco, California, taken off *Mus norwegicus*.

4. **C. penicilliger**, Grube*. The prothoracic comb consists of 20–22 spines. The movable process of the clasper of the ♂ is widest proximally to the centre and bears here at the hind edge two short, thick, obtuse spines; between these spines and the tip of the movable process there are two short, but rather strong, pointed bristles, the lower one pointing downwards and the upper one upwards. The eighth sternite is long and bears two very long bristles at the tip. The sternite of the seventh abdominal segment of the ♀ is, on each side, divided by a very shallow sinus into two rounded lobes.—Found on rodents and small carnivora in Europe and North Asia; one specimen taken off *Mus norwegicus* at Rannoch, Scotland. This flea, like *Ctenophthalmus agyrtes*, is very common on field-mice in England.

5. **C. niger**, Fox. The comb of the prothorax consists of at least 28 spines. The sternite of the eighth abdominal segment of the male is long and rod-like and bears a number of long bristles at the apex (fig. 23); (this sternite is practically lost in *fasciatus* and *londiniensis*). The receptaculum seminis of the female is long and slender, the proximal portion being but little wider than and almost twice the length of the distal portion, while in the two above-mentioned species the proximal portion is short and globular.—A bird-flea from California, but also occurring on rats.

## 9. Genus Pygiopsylla, Rothsch.

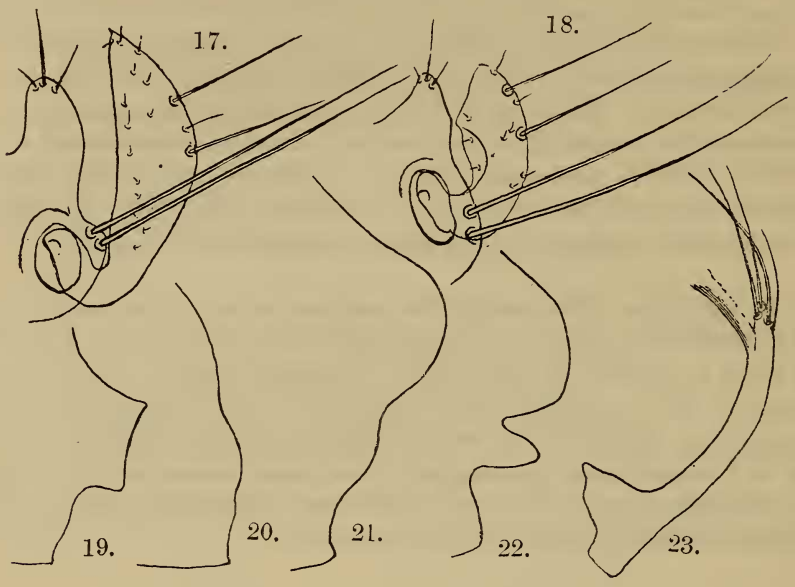
A number of species are known from the tropical countries of the eastern hemisphere, two being recorded from rats. Specimens of both these fleas have been sent from Australia labelled "from *Mus rattus*"; but subsequent examinations of large numbers of this animal in the same locality have not yielded any more. As both fleas are common on *Mus assimilis*, a purely Australian animal, it is probable that the hosts called *rattus* were really *assimilis*.

1. **P. hilli**, Rothsch. The sternite of the third abdominal segment in the ♂ bears on the two sides together about 20, or fewer, slender hairs in front of the postmedian row of long bristles; the movable process of the clasper is about half as long again as the non-movable process. In the ♀ the anal sternite (fig. 15) is notched beneath.—Australia.

2. **P. rainbowi**, Rothsch. A larger species. In the ♂ the sternite of the third abdominal segment bears on the two sides together more than 40 hairs in front of the postmedian row of long bristles; the movable process of the

* Dr. C. Tiraboschi, and others following him, have erroneously recorded *C. consimilis*, Wagner, *C. lagomys*, Wagner, and *C. mustelæ*, Dale, as being found on rats in Europe.

clasper is about one-fourth longer than the non-movable process. In the ♀ the anal sternite is evenly convex beneath (fig. 16).




## 10. Genus Chiastopsylla, Rothsch.

The genus includes a few species from South Africa, one of which has been obtained from a rat.

1. **Ch. rossi**, Waterst. Only one female known, which was taken off a rat in South Africa. Probably a common insect.

## 11. Genus Neopsylla, Wagn.

Very near *Ctenophthalmus*, but easily distinguished by the fifth tarsal segments bearing no ventral pair of bristles in between the first lateral pair. A small number of Palæarctic species, one of which was obtained from a rat.

1. **N. bidentatiformis**, Wagn. Head with two spines at the genal edge nearly as in *Chiastopsylla* (fig. 26).—Russia.

### 12. Genus Ctenophthalmus, Kolen.

The species are numerous. The eye is vestigial; the head bears a comb, and about midway between the palpi and the antennal groove there is a distinct frontal tubercle situated in a groove. Two species are recorded from rats.

1. **Ct. agyrtes**, Heller. The genal comb consists of three teeth and the pronotal one of sixteen. The non-movable process of the clasper of the male (fig. 25) is separated by a sinus into a conical upper lobe and a shorter and broader lower lobe, the latter being sinuate; the movable process is conical. In the female the sternite of the seventh abdominal segment (fig. 22) is produced into a broad rounded lobe, beneath which there is a narrow second lobe.—This is a European species, common in England on field-mice and bank-voles, and occurring also on *Mus norwegicus* when captured in the open.

2. **Ct. assimilis**, Tasch. The genal comb consists of three teeth and the pronotal one of eighteen. In the ♂ the non-movable process of the clasper (fig. 24) is short and broad and bears a number of long bristles; the movable process has the shape of a boot held with the sole upwards. The sternite of the seventh abdominal segment of the female (fig. 21) is produced into a broad rounded lobe, beneath which the edge of the segment is twice slightly incurved.—The species is found in Central Europe on field-mice; it is common in Germany on *Arvicola arvalis*, and has also been recorded from rats; it is apparently not found in England.

### 13. Genus Ctenopsylla, Kolen.

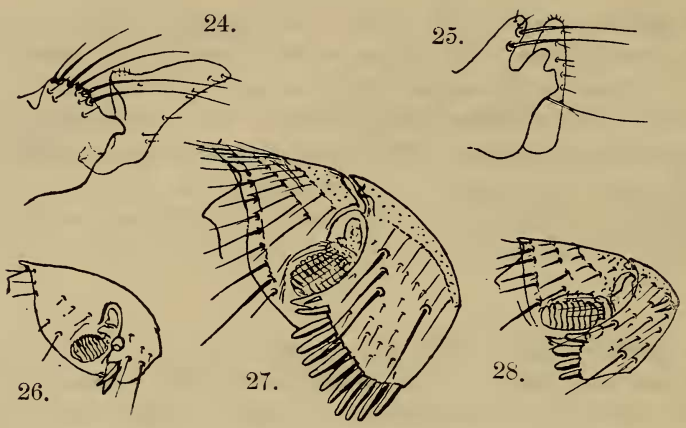
The species are easily recognised by the shape of the head (fig. 28) and the comb-like arrangements of the bristles at the hind edge of the tibiæ. One of the species has been obtained from rats.

1. **Ct. musculi**, Dugès. Two of the bristles near the front angle of the head are spine-like.—A widely distributed species, very common on rats and mice, especially *Mus musculus*, with which it has spread.

### 14. Genus Hystrichopsylla, Tasch.

The few known species are all large and very hairy fleas, which are at once recognised by the abdomen bearing one or more combs and the eye being absent or vestigial. One species has been found on rats.

1. **H. tripectinata**, Tirab. The comb of the head is restricted to the lower edge of the gena (fig. 27). The abdomen bears one comb, which is situated on the first tergite, each of the other tergites bears some small apical spines.—This is a Mediterranean species which occurs on mice and rats; it has also been found in the Azores.




The Californian ground squirrel *Citellus beecheyi* has been proved to play an important part in plague infection in California. A full account of the fleas of this animal is given in U.S.A. Public Health Reports, vol. xxiv. no. 29, 1909, Washington, Government Printing Office.